

DAIC and PICA Mutation

After many years of faithful service the two HP1000/F's (aka DAIC and PICA) used for data acquisition and instrument control have been retired as of December 1, 1989. Their functions have now been replaced by the new HP9000 systems running Unix.

The retirement of the DAIC and PICA will only affect observers bringing their own instruments and observers who regularly observe in the "back room". We will no longer offer access to an HP1000/F system for visiting instruments nor will we offer access to CAMAC for visiting instruments.

There will be no access to the bonnettes from the "back room" for first semester 1990. The telescope operators regularly control both the bonnettes and televisions and have proven to be very proficient at this task.

The DAIC and PICA will retire from data acquisition service but will remain on site to serve as spares for the TCS system which is still HP1000 based.

Their pseudonyms will not be vacant for long — the two HP9000 series 800's will become known as DAIC and PICA immediately.

Bernt Grundseth and Rick McGonegal

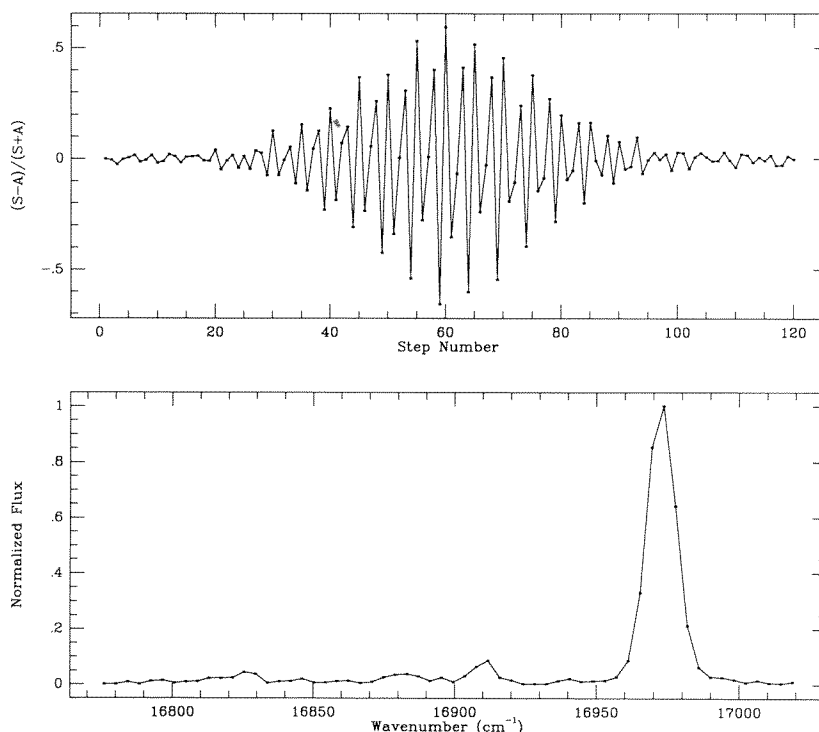
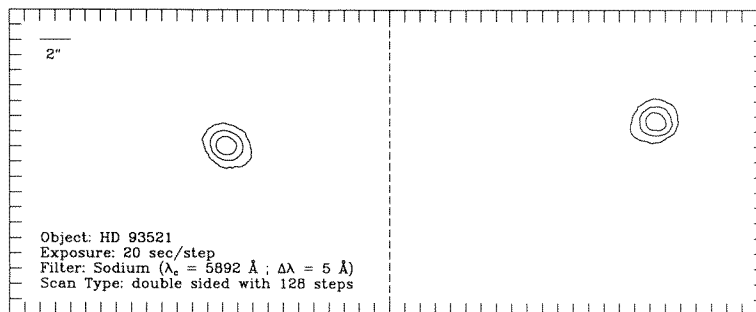


Figure 11

First 2D Spectroscopy Tests in the IR with a CCD and the FTS

Introduction

The FTS has been successfully coupled to the Institute for Astronomy's 800x800 optical CCD, in an effort to make a Fourier imaging spectrometer. The primary goal of the FTS-CCD interface project has been to create an instrument that is capable of making both high spatial and spectral resolution observations of a variety of objects. Possible applications include very efficient velocity dispersion mapping of galaxies and star clusters, as well as high resolution imaging/spectroscopy of complex line emission fields.

Basic Design

The system is based upon an optical interface that re-images the telescope's focal plane onto the 800x800 CCD through the FTS optical train. With this technique a pair of

complimentary images are formed at the CCD focal plane through each of the FTS's output beams. The 1:1 magnification of the interface optics provides a maximum field of view of $\sim 20''$ with a plate scale of $0.2 \text{ arcsec pixel}^{-1}$. As the FTS steps through different mirror positions, images are recorded by the CCD and written to magnetic tape. In order to maximize the system's efficiency no more than 100 rows are actually clocked out of the CCD at the end of each integration, depending on the selected field of view. The FTS mirror steps and CCD integrations are synchronized through an electronic interface between the already existing FTS and CCD support electronics. Since the electronic interface was designed to be essentially "transparent" to the FTS and CCD control systems, only minor modifications to the FTS and CCD were needed to electronically link the entire system.

Preliminary Results

The system was characterized during a pair of two-night observing runs during 1989. Though both runs were significantly hampered by poor weather, enough data were acquired to determine the basic viability of the system. During the first run, several stars and a globular cluster were ob-

served at a relatively low spectral resolution ($R \sim 1000$). Depicted in the accompanying figure, from top to bottom, are an image, interferogram, and spectrum of the star HD 93521. These observations were made through a 5 Å sodium filter with 20 second integrations at each mirror position. Since the spectral resolution was kept quite low, the final spectrum is simply the transmission curve of the sodium filter. The photometry data used to generate the interferogram were extracted with software apertures that were centered on the images of the star through the symmetric and asymmetric FTS beams. A number of improvements were made to the system after the first run to permit much higher spectral resolution observations. A combination of poor weather and unexpected problems with flat-fielding images when operating the system in a high resolution mode led to relatively poor results during our second run. Nevertheless, the flat-fielding problems encountered during the second run are now well understood and, when corrected during the planned 1990 observations, high quality spectra and images are expected.

Various tests have revealed that the system throughput

was $\sim 7\%$ at ~ 6000 Å. This translates into a detection level ($\sim 5 \sigma \text{ pixel}^{-1}$) or $\sim 17 \text{ mag arcsec}^{-2}$ if 30 second exposures are used through a 50 Å bandpass filter centered near 6000 Å. The fringe visibility was found to be typically $\sim 70\%$. A fairly extensive data processing package has been developed at the Institute for Astronomy to support the project. The amount of time required to process a data cube and generate spectra on a VAX 11/785 has been found to be typically 30-60 minutes, depending on the size of the cube and the processing parameters desired.

Future

Overall we have been very pleased with the progress made on this rather complex project and are looking forward to its many future scientific applications. Planned modifications to the system include the use of a large format infrared array as a detector to permit infrared observations. We are also considering the incorporation of dispersing elements in the interface to boost the system's efficiency.

D. Simons, L. Cowie

RECENT TECHNICAL ACTIVITIES

Primary Mirror Image Quality Evaluation and Improvements

Introduction

In late 1987 we initiated an ongoing program of telescope image quality evaluation and improvement. The goal of the program is to obtain the best image quality possible at the telescope. Although these efforts are by no means complete we thought it would be useful to describe what has been accomplished to date.

As early as 1982 it was seen that the optics were not always performing up to expectations. Observers noted that images on either side of focus were often clearly astigmatic. Knife-edge images of the pupil were at times abnormal. Studies of the site quality of Mauna Kea indicate that it is capable of delivering images with a full width at half maximum of 0.4 arcseconds or better much of the time. The primary mirror should produce images with a diameter of 0.2 arcseconds. So why is our mean image size never better than 0.7 arcseconds?

After ad-hoc attempts failed to determine the origins of the imaging problems we decided that a formal image characterization and improvement program was called for. To date we have concentrated on the imaging performance at the prime, cassegrain f/8 and cassegrain f/36 infrared foci. As a result we have improved the primary mirror support system (August 1989) and decided to replace the infrared f/36 secondary mirror.

The Tests

The primary mirror image quality was established by tests performed in the optical shop during fabrication. For a point source image they indicate that 50% of the encircled

energy should lie inside a diameter of 0.2 arcseconds. What wasn't clear at the beginning of the tests was how well the images obtained at the telescope, after removal of the effects of atmospheric turbulence, met the optical shop data. Nor was it clear what the relative contributions were from optical imperfections and atmospheric turbulence.

To answer these questions we are pursuing three more or less distinct experiments. The first is a qualitative inspection of in-focus and defocused CCD images at many positions over the sky. These provide a quick and very sensitive test of the total amount of aberration present in the optics, and give clues as to their type and origin. The second set of experiments involve quantitative measurements of individual aberrations using Hartmann and other tests. An alternative to the Hartmann test with which we are experimenting, based on the surface brightness of defocused point source images, is being developed by Francois and Claude Roddier at the University of Hawaii. Finally, measurements of the contribution of atmospheric turbulence to image size requires an interferometric test which is described in a separate article in this bulletin.

Early defocused images taken away from the zenith revealed a substantial problem with the primary mirror radial supports. An examples of support induced astigmatism can be seen in the lower right set of through-focus images in Figure 12. These images from the naked (uncorrected) prime focus were taken in June and August, 1989 immediately before and after work on the radial support system. The largely successful efforts taken to remove the support induced astigmatism during a major telescope shutdown in August 1989 are described by Jerry Sovka in a separate article in this bulletin.

A second defect seen in the zenith defocused images of Figure 12 is a different ratio between the diameter of the